

BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING MINOR

This minor provides specific training for McCormick students interested in industries that create and manufacture bio-based fuels and industrial chemicals, pharmaceuticals, biomaterials, and agents for gene and cell therapies or for those desiring in-depth preparation for future graduate study in biotech research.

Course	Title
Requirements (10 units)	
6 courses in biological science and biochemical engineering:	
BIOL_SCI 201-0	Molecular Biology ^{1, 2, 3}
BIOL_SCI 202-0	Cell Biology ^{1, 2, 3}
BIOL_SCI 203-0	Genetics and Evolution ^{2, 3}
BIOL_SCI 301-0	Principles of Biochemistry
CHEM_ENG 375-0	Biochemical Engineering
CHEM_ENG 377-0	Bioseparations
Laboratory experience:	
The complete series of 0.34-unit laboratories or one unit of 399 independent study in an approved laboratory ⁴	
BIOL_SCI 232-0	Molecular and Cellular Processes Laboratory
BIOL_SCI 233-0	and Genetics and Molecular Processes Laboratory
BIOL_SCI 234-0	and Investigative Laboratory
3 electives providing opportunity for greater depth in both fundamental biology and engineering applications:	
1 course from Core Electives (p. 1)	
2 courses from Extended Electives (p. 1)	

¹ CHEM_ENG 275-0 Molecular & Cell Biology for Engineers may substitute for either one

² Prior to 2020, the introductory Biological Science sequence consisted of BIOL_SCI 215-0 Genetics and Molecular Biology, BIOL_SCI 217-0 Physiology, and BIOL_SCI 219-0 Cell Biology. The new intro sequence no longer includes Physiology. Students who have taken ALL of the older intro sequence courses will petition to use the older courses when completing the Minor Declaration form in MAS. Students who have taken only SOME of the older intro courses can discuss with the minor coordinator which additional courses to take and then petition to use the old courses in the Minor Declaration form in MAS. In general, students missing BIOL_SCI 215-0 Genetics and Molecular Biology will take BIOL_SCI 201-0 Molecular Biology, students missing BIOL_SCI 219-0 Cell Biology will take BIOL_SCI 202-0 Cell Biology, and students missing BIOL_SCI 217-0 Physiology will take BIOL_SCI 203-0 Genetics and Evolution to complete the intro sequence. Students should consult the minor advisor for guidance on completing these requirements.

³ The Biotech Minor requires 3 units of Biology coursework. Exemptions or course reductions are NOT granted for students taking the Biological Sciences Department placement test, and who test out of and skip BIOL_SCI 201-0 Molecular Biology. These students may complete BIOL_SCI 202-0 Cell Biology and BIOL_SCI 203-0 Genetics and Evolution and petition to use an upper level Biology course to complete the required 3 units of Biology coursework.

⁴ Biological Science laboratories are now connected to the intro sequence courses, and registration in the lab is required. Biological Science laboratories were previously numbered BIOL_SCI 220-0,

BIOL_SCI 221-0, and BIOL_SCI 222-0. Students who have already completed these laboratory courses with the older numbering may continue to use them toward the minor, or use a previously approved independent study.

- A minimum GPA of 2.0 is required in courses in the minor.
- A BA or BS degree from Northwestern must be completed.
- No more than 6 units may be double-counted to fulfill requirements in the major program for catalog years 2022 to present. For catalog years 2021 and earlier, no more than 5 units may be double-counted to fulfill requirements in the major program.
- A maximum of 2 units not offered by the department may be taken P/N for the minor. Students must also comply with departmental and McCormick P/N regulations for courses that are double-counted toward requirements in the minor and major programs.
- Students not majoring in chemical engineering should take the Biological Sciences intro sequence BIOL_SCI 201-0 Molecular Biology, BIOL_SCI 202-0 Cell Biology, BIOL_SCI 203-0 Genetics and Evolution (former intro sequence was BIOL_SCI 215-0 Genetics and Molecular Biology, BIOL_SCI 217-0 Physiology, BIOL_SCI 219-0 Cell Biology), and BIOL_SCI 301-0 Principles of Biochemistry before CHEM_ENG 375-0 Biochemical Engineering and CHEM_ENG 377-0 Bioseparations. They should also take CHEM 342-1 Thermodynamics and the recommended BIOL_SCI 315-0 Advanced Cell Biology to prepare for CHEM_ENG 375-0 Biochemical Engineering and CHEM_ENG 377-0 Bioseparations.
- Students must submit an up to date minor declaration form in MAS (McCormick Advising System) (<https://mas.mccormick.northwestern.edu/>) before the beginning of their final quarter as undergraduates.

Minor Electives

Core Electives

Course	Title
CHEM_ENG 372-0	Bionanotechnology
CHEM_ENG 373-0	Biotechnology and Global Health
CHEM_ENG 376-0	Principles of Synthetic Biology
CHEM_ENG 378-0	Deconstructing Synthetic Biology – Biotechnology Case Studies Across Scales
CHEM_ENG 379-0	Computational Biology: Analysis and Design of Living Systems
CHEM_ENG 382-0	Regulatory Sciences in Biotechnology
CHEM_ENG 470-0	Molecular Folding and Function
CHEM_ENG 478-0	Advances in Biotechnology
CHEM_ENG 395-0	Special Topics in Chemical Engineering (must be approved by petition)

Extended Electives

Course	Title
CHEM_ENG 372-0	Bionanotechnology
CHEM_ENG 373-0	Biotechnology and Global Health
CHEM_ENG 376-0	Principles of Synthetic Biology
CHEM_ENG 378-0	Deconstructing Synthetic Biology – Biotechnology Case Studies Across Scales
CHEM_ENG 379-0	Computational Biology: Analysis and Design of Living Systems
CHEM_ENG 382-0	Regulatory Sciences in Biotechnology
CHEM_ENG 470-0	Molecular Folding and Function

CHEM_ENG 478-0	Advances in Biotechnology
CHEM_ENG 395-0	Special Topics in Chemical Engineering (must be approved by petition)
BIOL_SCI 315-0	Advanced Cell Biology
BIOL_SCI 323-0	Bioinformatics: Sequence and Structure Analysis
BIOL_SCI 328-0	Microbiology
BIOL_SCI 332-0	Conservation Genetics
BIOL_SCI 341-0	Population Genetics
BIOL_SCI 353-0	Molecular Biology Laboratory
BIOL_SCI 355-0	Immunobiology
BIOL_SCI 361-0	Protein Structure and Function
BIOL_SCI 363-0	Biophysics
BIOL_SCI 378-0	Functional Genomics
BIOL_SCI 380-0	Biology of Cancer
BIOL_SCI 390-0	Molecular Biology of Genome Editing and Engineering
BIOL_SCI 395-0	Molecular Genetics
BMD_ENG 304-0	Quantitative Systems Physiology (Formerly BMD_ENG 302)
BMD_ENG 317-0	Biochemical Sensors
BMD_ENG 340-0	Pharmaceutical Engineering: From Discovery to Therapeutics
BMD_ENG 343-0	Biomaterials and Medical Devices
BMD_ENG 344-0	Biological Performance of Materials
BMD_ENG 346-0	Tissue Engineering
BMD_ENG 347-0	Foundations of Regenerative Engineering
BMD_ENG 348-0	Applications of Regenerative Engineering
BMD_ENG 443-0	Biological Phenomena in Cell/Cell-Free Systems
BMD_ENG 446-0	Biomaterials in Synthetic Biology
CHEM 215-3	Organic Chemistry III (Formerly CHEM 210-3)
CIV_ENV 361-1	Environmental Microbiology
CIV_ENV 442-0	Environmental Biotechnology for Resource Recovery
MAT_SCI 353-0	Bioelectronics
MAT_SCI 370-0	Biomaterials
Independent Study 399 in approved laboratory	